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Indian Standard

SPECIFICATION FOR COLD-ROLLED STEEL STRIPS FOR SPRINGS

(First Revision)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 4 *April* 1976

Indian Standard
SPECIFICATION FOR COLD-ROLLED STEEL STRIPS FOR SPRINGS
(First Revision)

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(*Continued on page* 16)

Indian Standard

SPECIFICATION FOR COLD-ROLLED STEEL STRIPS FOR SPRINGS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 November 1975, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1965. While reviewing the standard in the light of the experience gained since its publication, the committee found it necessary to incorporate the surface and edge conditions, decarburization and some additional physical characteristics in the revised version of the standard. The designations of steels (*see* Table 1) have also been brought in line with IS : 1762 (Part I)-1974*.

0.3 Cold-rolled steel strips covered by this standard may be used in the as rolled or annealed as well as in the hardened and tempered condition for the manufacture of steel springs for various purposes. Most of the products made from cold-rolled or annealed steel strips are heat-treated to obtain tensile strength values specified by hardening and tempering.

0.4 Hardening and tempering is the usual treatment applied to steels covered by this standard. An advantageous process for increasing the fatigue strength of these steels is heating them to hardening temperature while simultaneously carbo-nitriding the surface.

0.5 For the benefit of the purchaser, an informative appendix (*see* Appendix A) giving particulars to be specified while ordering for the steel strips, has been included.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS:2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Code for designation of steels: Part I Based on letter symbols (*first revision*).

†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers the requirements for cold-rolled steel strips for the manufacture of springs for various purposes.

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of steel strips shall conform to IS : 1387-1967*.

3. MANUFACTURE

3.1 Steel shall be manufactured by the open hearth, electric, duplex, basic oxygen or a combination of these processes. In case any other process is employed by the manufacturer, prior approval of the purchaser shall be obtained.

3.1.1 Steel shall be of killed type.

4. GRADES

4.1 Steel strips shall be one of the eleven grades specified in Table 1.

5. FREEDOM FROM DEFECTS

5.1 Strips shall be free from harmful defects, such as scale, rust, blisters, laminations, cracked edges, etc.

NOTE — Where coil is supplied, the degree or amount of surface defects may be expected to be more than in cut lengths because of the impossibility of rejecting portions of a coil. This shall be taken into account by the purchaser in his assessment of the material. An excessive amount of defects may be cause for rejection.

5.1.1 In case strips are supplied with mill edges, complete plus partial decarburization, as indicated by the proportion of ferrite, shall not extend to a depth below the surface greater than 3 percent of the nominal thickness of the material at a distance not less than 20 mm from the edge.

5.1.2 In case of strips supplied with slit edges, decarburization shall not exceed 3 percent at any point of the strip.

5.2 Strips shall be usually supplied with mill edges. When supplied with sheared edges, the edges shall be free from burrs.

5.2.1 Any edge condition other than that mentioned in 5.2 shall be subject to mutual agreement between the purchaser and the supplier.

---

*General requirements for the supply of metallurgical materials (*first revision*).

TABLE 1 CHEMICAL COMPOSITION

(*Clauses* 0.2, 4.1, 6.1 *and* 6.2)

GRADE	DESIGNATION [*see* IS:1762 (PART I)-1974*]	CONSTITUENT						
		Carbon, Percent	Silicon, Percent	Manganese, Percent	Sulphur, Percent, *Max*	Phosphorus Percent, *Max*	Chromium, Percent	Vanadium, Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	45C 8	0·40 to 0·50	0·10 to 0·35	0·60 to 0·90	0·050	0·050	—	—
2	55C 6	0·50 „ 0·60	0·10 „ 0·35	0·50 „ 0·65	0·050	0·050	—	—
3	65C 6	0·60 „ 0·70	0·10 „ 0·35	0·50 „ 0·80	0·050	0·050	—	—
4	70C 6	0·65 „ 0·75	0·10 „ 0·35	0·50 „ 0·80	0·050	0·050	—	—
5	75C 6	0·70 „ 0·80	0·10 „ 0·35	0·50 „ 0·80	0·050	0·050	—	—
6	80C 6	0·75 „ 0·85	0·10 „ 0·35	0·50 „ 0·80	0·050	0·050	—	—
7	85C 6	0·80 „ 0·90	0·10 „ 0·35	0·50 „ 0·80	0·050	0·050	—	—
8	98C 6	0·90 „ 1·05	0·10 „ 0·35	0·50 „ 0·80	0·050	0·050	—	—
†9	55Si7	0·50 „ 0·60	1·50 „ 2·00	0·80 „ 1·00	0·050	0·050	—	—
10	50Cr4	0·45 „ 0·55	0·10 „ 0·35	0·60 „ 0·90	0·050	0·050	0·90 to 1·20	—
11	50Cr4V2	0·45 „ 0·55	0·10 „ 0·35	0·50 „ 0·80	0·050	0·050	0·90 „ 1·20	0·15 to 0·30

*Code for designation of steels: Part I Based on letter symbols (*first revision*).

†For the manufacture of this grade of steel, basic oxygen process may be used with the prior consent of the purchaser.

6. CHEMICAL COMPOSITION

6.1 The ladle analysis of the material, when analysed in accordance with the appropriate part of IS : 228*, shall be as given in Table 1.

6.2 Product Analysis — The permissible variation in the case of product analysis from the limits specified in Table 1 shall be as follows:

Constituent	*Permissible Variation Over Specified Limits* Percent
Carbon	±0·03
Manganese	±0·04
Silicon	±0·03
Sulphur	+0·005
Phosphorus	+0·005
Chromium	±0·03
Vanadium	±0·02

NOTE — Variations shall not be applicable both over and under the specified limits in several determinations in a heat.

7. ROLLING TOLERANCES

7.1 Tolerance on thickness of the steel strip shall be as specified in Table 2. The thickness of the steel strip shall be measured at a position not less than 10 percent of the ordered width from the edge for widths up to and including 75 mm. For higher widths the position of measurement of thickness shall be not less than 10 mm from the edge.

7.1.1 The variation in thickness of material across the width shall not exceed half the total tolerance given in Table 2.

7.1.2 Tolerances other than those specified in Tables 2 and 3 are subject to mutual agreement between the purchaser and the supplier.

7.2 Materials when supplied shall be reasonably flat. Dish (concavity across width) in hardened and tempered strips shall not exceed 0·025 mm per 25-mm width or part thereof for thickness up to and including 1·5 mm and 0·035 mm per 25-mm width or part thereof for thickness over 1·5 mm (*see* Fig. 1).

7.2.1 When a 5-m length of strip is allowed to lie on a flat surface by its own weight, no part of the strip shall lift more than 5 mm from the flat surface. For this purpose, rise should be measured from the surface nearer to the flat surface.

---

*Methods of chemical analysis of steels (*second revision*). (Being issued in parts).

TABLE 2 TOLERANCES ON THICKNESSES OF STEEL STRIPS

(*Clauses* 7.1, 7.1.1 *and* 7.1.2)

All dimensions in millimetres.

THICKNESS*	TOLERANCE FOR WIDTHS				
	Up to and Including 100	Above 100 Up to and Including 125	Above 125 Up to and Including 250	Above 250 Up to and Including 400	Above 400 Up to and Including 650
(1)	(2)	(3)	(4)	(5)	(6)
0·10	±0·01	±0·01	—	—	—
0·15	±0·01	±0·01	±0·02	±0·02	±0·02
0·20	±0·02	±0·02	±0·02	±0·02	±0·03
0·25	±0·02	±0·02	±0·02	±0·03	±0·03
0·30	±0·02	±0·02	±0·03	±0·03	±0·03
0·40	±0·02	±0·03	±0·03	±0·03	±0·04
0·50	±0·03	±0·03	±0·03	±0·04	±0·04
0·60	±0·03	±0·03	±0·04	±0·04	±0·05
0·80	±0·03	±0·04	±0·05	±0·05	±0·05
1·00	±0·04	±0·04	±0·05	±0·06	±0·06
1·25	±0·04	±0·05	±0·06	±0·06	±0·07
1·50	±0·05	±0·05	±0·06	±0·07	±0·08
1·80	±0·05	±0·06	±0·07	±0·08	±0·08
2·00	±0·06	±0·06	±0·07	±0·08	±0·09
2·50	±0·06	±0·07	±0·08	±0·09	±0·10
3·00	±0·07	±0·08	±0·09	±0·10	±0·11
3·55	±0·08	±0·09	±0·10	±0·11	±0·12
4·00	±0·08	±0·09	±0·11	±0·12	±0·13
5·00	±0·09	±0·10	±0·13	±0·14	±0·15

*When intermediate thicknesses are specified, the tolerance of the next larger thickness step is applicable.

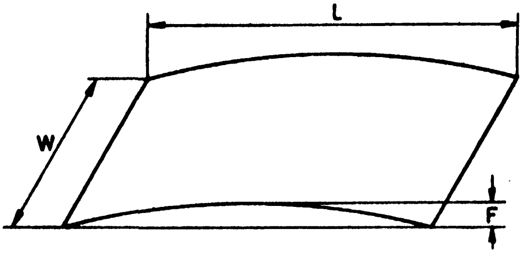
7.3 The tolerances on width when supplied in sheared or mill edges shall be as given in Table 3. When the strip is supplied in the round or dressed edge condition, the tolerance on minus side shall also be permissible, which shall be up to 0·5 mm, *Max*.

TABLE 3 TOLERANCES ON WIDTH WHEN SUPPLIED IN MILL EDGE AND SHEARED EDGE

(*Clauses* 7.1.2 *and* 7.3)

All dimensions in millimetres.

NOMINAL THICKNESS	TOLERANCE ON NOMINAL WIDTH						
	Up to and Including 100	Above 100 Up to and Including 125	Above 125 Up to and Including 250	Above 250 Up to and Including 320	Above 320 Up to and Including 400	Above 400 Up to and Including 500	Above 500 Up to and Including 600
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			For Mill Edge				
0·10 to 5·0	±1·5	±1·6	±2·2	±2·5	±3·3	±4·4	±6
			For Sheared Edge				
0·10 „ 0·60	±0·15	±0·2	±0·25	±0·3	±0·4	±0·5	±0·6
0·61 „ 1·00	±0·2	±0·25	±0·3	±0·35	±0·45	±0·55	±0·65
1·01 „ 2·00	±0·25	±0·3	±0·4	±0·5	±0·6	±0·7	±0·8
2·01 „ 3·00	±0·3	±0·4	±0·5	±0·6	±0·7	±0·85	±1·0
Above 3	Subject to agreement						



W = Width of strip
L = Length of strip
F = Variation from flatness

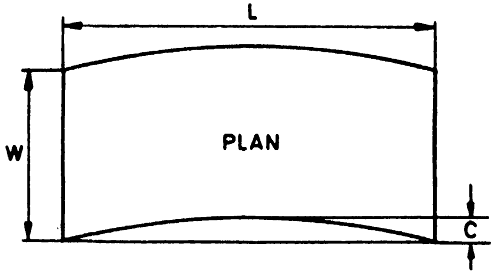
FIG. 1 FLATNESS OF STRIP

7.4 Edge camber (lateral departure of the edge of the material from straight line forming a chord) shall not exceed the tolerances given in Table 4 (*see* Fig. 2).

TABLE 4 TOLERANCES ON EDGE CAMBER FOR COLD-ROLLED UNHARDENED, HARDENED AND TEMPERED STEEL STRIPS

All dimensions in millimetres.

Specified Width		Specified Thickness		Maximum Tolerance on Edge Camber in any 2 000-mm Length	
Over	Up to and Including	Over	Up to and Including	Cold Rolled Unhardened	Hardened and Tempered
(1)	(2)	(3)	(4)	(5)	(6)
—	50	—	2	10	2
—	50	2	—	13	3
50	250	—	2	6·5	2
50	250	2	—	13	3
250	600	—	2	6·5	2
250	600	2	—	13	3



W = Width of strip
L = Length of strip
C = Edge camber

FIG. 2 EDGE CAMBER OF STRIP

8. CALCULATION

8.1 The weight of steel strips shall be calculated on the basis that steel weighs 7·85 g/cm^3.

9. TREATMENT

9.1 The material may be supplied in the cold-rolled, annealed or hardened and tempered condition or in any other condition subject to mutual agreement between the purchaser and the supplier. Recommended heat treatment for the material is given in Appendix B.

10. PHYSICAL PROPERTIES

10.1 Physical properties of cold-rolled steel strips for springs are given in Appendix C for information.

10.2 When specified in the order, the frequency of tests for physical properties shall be subject to mutual agreement between the purchaser and the supplier.

11. DELIVERY

11.1 The material shall be delivered either in coils or in straight lengths as agreed to between the purchaser and the supplier.

12. SURFACE CONDITION

12.1 The surface of cold-rolled, annealed or hardened and tempered steel strip, when delivered, may be either dull, bright, polished, or polished and tempered.

12.2 Strips shall be adequately coated with rust-preventive oil as agreed to between the purchaser and the supplier.

13. PACKING

13.1 Strips shall be supplied in coils or bundles of cut lengths or in packages each weighing not more than three tonnes as may be agreed to between the purchaser and the supplier.

13.2 Strips shall be packed in waterproof paper or polythene or polythene-lined hessian and securely tied around with hoop iron. A number of coils may be bundled with wooden battens in between or may be packed in wooden boxes. Strips may also be packed with separate thin metallic sheets wrapped around and with bands of hoop iron.

14. MARKING

14.1 Each bundle or package of steel strips shall be legibly marked with the name or trade-mark of the manufacturer; size; grade; and the cast number or identification mark, by which the steel can be traced to the cast or casts which it represents. Steel designation should also be marked on each bundle or package.

14.2 BIS Certification Marking

The product may also be marked with Standard Mark.

14.2.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

15. SAMPLING

15.1 Sampling for Chemical Analysis — The ladle sample analysis shall be supplied by the manufacturer. If the product analysis is required by the purchaser, at least one sample product shall be taken from each cast.

15.1.1 For product analysis the selection of samples shall be carried out in accordance with 'Indian Standard methods of selection and preparation of samples for product analysis' (*under preparation*) (*see* Note).

NOTE — Till such time the standard under preparation is published, sampling plan shall be as agreed to between the parties concerned.

15.2 Sampling for Mechanical Tests — If required for the purpose of mechanical tests, one sample for every 20 tonnes or part thereof with a minimum of one per cast shall be selected.

15.2.1 Test pieces for mechanical properties shall be taken in the direction of the fibre, the rolling direction.

15.3 Selection and preparation of samples and test pieces shall be in accordance with IS: 3711-1966*.

16. RETEST

16.1 Should any one of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected from the same lot for testing in respect of each failure. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirements of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test samples shall be deemed as not conforming to this standard.

---

*Method for selection and preparation of samples and test pieces for mechanical tests for wrought steel.

APPENDIX A

(*Clause* 0.5)

INFORMATION TO BE GIVEN BY THE PURCHASER

A-1. BASIS FOR ORDER

A-1.1 While placing an order for the purchase of steel strips for springs covered by this standard, the purchaser should specify the following:

a) Description regarding grade, designation, size, etc;
b) Condition of delivery;
c) Method of manufacture;
d) Any special requirement; and
e) Test report, if required.

APPENDIX B

(*Clause* 9.1)

MECHANICAL WORKING AND HEAT TREATMENT

B-1. SHAPING

B-1.1 Shaping is performed cold by cutting, shearing, stamping, die pressing, bending and coiling. In case of difficulties being encountered in shaping, intermediate annealing is required. If hardened parts have to be annealed, the annealing temperatures stated in Table 5 shall be used, paying particular attention to the statements made in **B-2.1**.

TABLE 5 RECOMMENDED TEMPERATURE FOR THE HEAT TREATMENT OF COLD-ROLLED STEEL STRIPS

(*Clauses* B-1.1, B-2.1 *and* B-3.1)

GRADE	DESIGNATION	SOFT ANNEALING °C	HARDENING IN OIL °C	TEMPERING °C
(1)	(2)	(3)	(4)	(5)
1	45C 8	600 to 650	830 to 860	380 to 440
2	55C 6		820 ,, 850	390 ,, 450
3	65C 6		810 ,, 840	400 ,, 460
4	70C 6		800 ,, 830	420 ,, 500
5	75C 6		780 ,, 810	420 ,, 500
6	80C 6		780 ,, 810	430 ,, 510
7	85C 6		770 ,, 800	440 ,, 520
8	98C 6	620 ,, 660	770 ,, 800	280 ,, 340
9	55Si7	640 ,, 680	830 ,, 860	300 ,, 360
10	50Cr4	640 ,, 680	830 ,, 860	280 ,, 340
11	50Cr4V2			

B-2. ANNEALING

B-2.1 The material shall be progressively and uniformly heated to the temperature stated in Table 5 and soaked for a period depending upon the cross section and shall then be cooled down as slowly as possible (being left in the annealing furnace).

B-3. HARDENING AND TEMPERING

B-3.1 The material shall be progressively and uniformly heated to the hardening temperatures as indicated in Table 5 and soaked for a period depending on its cross section. The lower limits of the temperature ranges are applied to relatively small dimensions, the upper limits to the large dimensions. The tempering temperatures indicated in Table 5 (approximate values) have to be selected in accordance with the strength properties required. To maintain narrow ranges of strength properties by suitable hardening and tempering treatments, it is necessary to pay attention to the fact that the different casts as delivered may exhibit uniform hardening properties but may require certain gradations of the tempering temperatures. To avoid difficulties in maintaining the strength values required, it is, therefore, advisable to carry out the fabrication keeping the different casts separate. Tempering should be carried out directly after the hardening treatment to avoid cracking on hardening.

APPENDIX C

(*Clause* 10.1)

PHYSICAL PROPERTIES

C-1. PHYSICAL PROPERTIES OF COLD-ROLLED STEEL STRIPS FOR SPRINGS

C-1.1 Physical properties of cold-rolled steel strips in the annealed and hardened and tempered conditions are given in Table 6.

C-1.2 The Vickers hardness test shall be carried out in accordance with IS : 1501-1968*.

C-1.3 The tensile strength, yield stress and percentage elongation shall be determined in accordance with IS : 1663-1972† and IS : 1608-1972‡.

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*Method for Vickers hardness test for steel (*first revision*).

†Method for tensile testing of steel sheet and strip of thickness 0·5 mm to 3 mm (*first revision*).

‡Method for tensile testing of steel products (*first revision*).

AMENDMENT NO. 1 JUNE 1978

TO

IS : 2507-1975 SPECIFICATION FOR COLD-ROLLED STEEL STRIPS FOR SPRINGS

(First Revision)

Corrigendum

(*Page* 15, *Table* 6, *Note* 2, *line* 1) — Substitute 'L_e = 12·5 mm' *for* 'L_o = 12·5 mm'.

Alteration

(*Page* 6, *clause* 7) — Substitute '**TOLERANCES**' *for* '**ROLLING TOLERANCES**'.

Addendum

(*Page* 6, *clause* **7.2.1**) — Add the following Note and clause after **7.2.1**:

'*Note* — This is applicable to only hardened and tempered strips.

7.2.1.1 In case of cold-rolled strips supplied in coils the flatness tolerances shall be mutually agreed to between the purchaser and the manufacturer.'

(**SMDC 5**)

Printed at New India Printing Press, Khurja, India

AMENDMENT NO. 2 APRIL 1979

TO

IS:2507-1975 SPECIFICATION FOR COLD-ROLLED STEEL STRIPS FOR SPRINGS

(First Revision)

Alteration

(*Page 15, Table 6, heading of col 6*) - Substitute 'Elongation, Percent, *Min*, Gauge Length 5.65 $\sqrt{So}$' *for* 'Elongation, Percent, *Min*'

(SMDC 5)

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TABLE 6 PHYSICAL PROPERTIES

(*Clause* C-1.1)

GRADE	DESIGNATION	ANNEALED				HARDENED AND TEMPERED			
		Vickers Hardness *HV*, *Max*	Yield Stress N/mm², *Min*	Tensile Strength N/mm², *Max*	Elongation, Percent, *Min*	Vickers Hardness *HV*	Yield Stress N/mm², *Min*	Tensile Strength N/mm²	Elongation, Percent, *Min*, Gauge Length $5{\cdot}65\sqrt{S_0}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	45C 8	185	270	590	30	350 to 425	1 030	1 180 to 1 420	6
2	55C 6	195							
3	65C 6	205							
4	70C 6	215							
5	75C 6	220	290	640	25	350 ,, 475	1 080	1 180 ,, 1 570	6
6	80C 6	220							
7	85C 6	220							
8	98C 6	225	310	690	25	475 ,, 540	1 470	1 570 ,, 1 760	6
9	55Si7	240	340	780	20	475 ,, 570	1 470	1 570 ,, 1 960	6
10	50Cr4	240	340	780	20	505 ,, 650	1 570	1 670 ,, 2 260	5
11	50Cr4V2	240	340	780	20	555 ,, 670	1 760	1 880 ,, 2 360	4

NOTE 1 — 1 N/mm² = 1 MN/m² = 0·1020 kgf/mm².

NOTE 2 — The values for elongation for gauge length L_0 = 50 mm and L_0 = 12·5 mm should be reduced by about one-third the values specified for gauge length $L_0 = 5{\cdot}65\sqrt{S_0}$.

NOTE 3 — The strength values for the strips in the hardened and tempered conditions depend on the thickness. In view of the fact that the strength values are also influenced by the rolling stresses, the strength properties should be subject to mutual agreement between the purchaser and the supplier.

NOTE 4 — Since slight surface decarburization is unavoidable, the hardness values specified may be considered approximate.

(*Continued from page* 2)

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones: 323 0131, 323 3375, 323 9402
Fax : 91 11 3234062, 91 11 3239399, 91 11 3239382

Telegrams : Manaksanstha
(Common to all Offices)

Central Laboratory:	**Telephone**
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*Sales Office is at 5 Chowringhee Approach, P. O. Princep Street, CALCUTTA 700072	27 10 85
†Sales Office is at Novelty Chambers, Grant Road, MUMBAI 400007	309 65 28
‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square, BANGALORE 560002	222 39 71

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